Night Vision Goggle Clip
"Make vs. Buy" Study

Project Number #NP06012111

Final Report
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Letterkenny Army Depot
Chambersburg, PA

Submitted by

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14. ABSTRACT

Letterkenny Army Depot (LEAD), located in Chambersburg PA, received an order to manufacture 12,000 night vision goggle (NVG) plates. These plates are used to mount the NVG to the Soldier's helmet. However, the quantities needed had increased over four fold from 12,000 to 52,000 (7,000 NVG plates per month) near the time of production. Based on these quantities, delivery dates, and current workload, LEAD requested the assistance of the National Center for Defense Manufacturing and Machining (NCDMM) to help optimize the NVG plate manufacturing process. The optimized tooling and tool path resulted in a 30% reduction in cycle time compared to the original program. Implementing this solution enables LEAD to meet its increased production schedule of 52,000 plates. This improvement also reduces the estimated cost $2.18 per NVG plate.

15. SUBJECT TERMS
NCDMM; LEAD; Night Vision Goggle

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Letterkenny Army Depot Engineering Support

Night Vision Goggle Clip "Make vs. Buy" Study

1.0 EXECUTIVE SUMMARY

The National Center for Defense Manufacturing and Machining (NCDMM) was requested to assist Letterkenny Army Depot (LEAD) in performing a "Make vs. Buy" study for the A3297308-2 clip, part of the A3297308 Front Bracket Assembly, figure 1, used on the ACH/CVC helmet Night Vision Goggle (NVG) kit.

LEAD has the capability to manufacture this part using their existing laser cutter and press brake equipped with new in-house built forming tooling. This approach yields the lowest cost of $1.44 per part. This assumes other approaches must amortize the cost of more expensive tooling and machinery over the first order for 52,000 parts.

However, if there is a significant increase in quantities or orders for follow-on production, it may be economically beneficial to purchase an automatic forming machine. Once the machine cost is amortized over the first order, the part cost drops dramatically from $1.86 to $0.74, whereas the existing equipment approach only decreases to $1.34 for future quantities.

Purchasing the part on the outside has the highest initial cost of $2.03 per part, including tooling amortization on the first order, with the part cost dropping to $1.38 for future quantities.

Figure 1. NVG Front Bracket Assembly

2.0 **INTRODUCTION**

2.1 The National Center for Defense Manufacturing and Machining (NCDMM) was requested to assist Letterkenny Army Depot (LEAD) in performing a "Make vs. Buy" study for the A3297308-2 clip, part of the A3297308 Front Bracket Assembly, figure 1, used on the ACH/CVC helmet Night Vision Goggle (NVG) kit.

LEAD has the capability to manufacture the clip using their existing equipment; however, there are several options that should be considered when looking at the overall capacity of the shop and the potential for follow-on orders.

2.2 Various methods of manufacture are available for the clip. Because of the short lead-time and high volume (52,000 pieces), 3 different scenarios were investigated:

- **LEAD manufacture in-house using existing equipment and new tooling for the manually operated press brake.**
- **LEAD manufacture in-house using a new automatic forming machine.**
- **Purchase finished parts from an outside vendor.**

2.3 The major areas of concern in the comparison analysis were:

- Overall cost.
- Effect on LEAD's capacity, while maintaining day-to-day operations.
- Generating direct labor hours for overhead absorption.
- Impact of amortized capital cost on piece part cost on existing and future orders.

3.0 **ANALYSIS**

Attachment "A" contains the estimated cost details for each scenario in the cost analysis.

3.1 **LEAD manufacture in-house using existing equipment and new tooling for the manually operated press brake.**

This approach is the path currently being followed by LEAD. The laser cutter is used to create 2' x 4' pallets with 135 blank parts per pallet, each part retained by small tabs for ease of handling. The laser cutter cycle

time for one 4' x 8' sheet is approximately 2.25 hours, yielding 15 seconds per part.

The parts are then transferred to the forming area, de-palletized and loaded into the press-brake by hand, currently 3 at one time for each operation station, "3 up". (A planned option to duplicate the tooling will enable "6 up" capacity and reduce cost.)

In the "6 up" configuration there are two forming operation stations, each holding 6 parts. After each press-brake cycle, 6 completed parts are removed from the press-brake, 6 partially formed parts transferred from the 1st station to the 2nd station and 6 blanks loaded in the 1st station. The cycle time from de-palletize to finished part is estimated by LEAD to be 1.5 minutes for 6 parts or 15 seconds per part.

If required, the parts will then be tumbled to remove burrs and sent out for anodizing.

The finished cost per part is $1.51 for "3 up" tooling and $1.44 for "6 up" tooling (including estimated tool cost). For future orders using this tooling, the cost per part drops to $1.34 for "6 up" tooling.

3.2 LEAD manufacture in-house using a new automatic forming machine.

This approach requires purchasing an automatic forming machine with specific tooling for the part to be manufactured for an estimated $45,000 (including installation and operator training).

The machine is completely automatic once loaded with a coil of bulk material. Completed parts are ejected from the machine at the rate of approximately 3 per second with no operator assistance needed. If required, the parts will then be tumbled to remove burrs and sent out for anodizing.

Figure 2 shows the construction of the press section of a typical automatic forming machine.

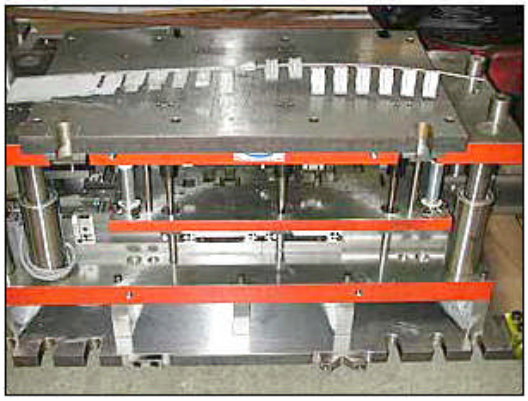

Figure 2. Typical Forming Machine Press Section

The machine consists of a coil unwind stand, straightening rolls with a hitch feed carrier strip advance to the press section. Several press cylinders controlled by a PLC would be used to progressively blank and form the clip while still attached to a carrier strip. The final operation cuts the completed part free from the carrier strip and ejects it into a container.

The machine requires 10' x 15' of floor space and operates from standard electrical and shop air hookups. The forming die typically requires sharpening every 75,000 parts at a cost of approximately $1,000 and the entire machine is capable of producing 1 million parts before overhaul.

For cost analysis, it was assumed that the machine was manned during operation at the cost of $0.07 per part. This machine is capable of producing an entire month's production of 7000 parts in one shift from a single 400 lb. coil of material.

The finished cost per part is $1.87 (including machine cost amortization over the first order). For future orders using this machine, the cost per part drops to $0.74.

3.3 **Purchased finished parts from an outside vendor.**

This approach consists of simply outsourcing the complete fabrication and anodizing to an outside vendor with stamping press capability.

Because the part is unique and to achieve the lowest cost, a stamping die must be built at an estimated cost of $26,000 with a lead-time of 10-12 weeks. The stamping die typically requires sharpening every 50,000 parts and has a useful life of approximately 1 million parts. Maintenance of the die by the vendor is included in the piece part price.

The cost per part is $2.03 including tooling for the first order and drops $1.38 for future orders using the same tooling.

4.0 **KEY DATA SUMMARY**

Table 1 summarizes the costs per part anticipated with each scenario on this current order and anticipated costs on follow-up orders of similar size.

Table 1. Piece Part Price Comparison

Scenario	Initial 52,000 parts (Includes equip & tooling) Cost $ Each	Follow-on Orders Cost $ Each
LEAD make, existing equip. (6 up)	1.44	1.34
LEAD make, new auto machine	1.87	0.74
Buy from outside vendor	2.03	1.38

Table 2 summarizes the man-hours generated and equipment utilization for each scenario.

Table 2. Capacity Impact (Current 52,000 piece Order)

Scenario	Man-hours per month	Equipment utilization (shifts per month)
LEAD make, existing equip. (6 up)	58.4	4.2 (each, laser and press)
LEAD make, new auto machine	7.0	1.0
Buy from outside vendor	0	0

5.0 CONCLUSIONS

5.1 LEAD manufacture in-house using existing equipment and new tooling for the manually operated press brake.

If there is no future demand for this part, LEAD manufacturing in-house may be the best scenario. The tooling must be produced anyway to meet the production schedule, it has the lowest piece part cost, generates man-hours and hopefully, does not exceed the existing equipment capacity. (A capacity analysis of the laser cutter and press-brake must be performed to determine exact available capacity.)

5.2 LEAD manufacture in-house using a new automatic forming machine.

If there is future production, the purchase of a special purpose automatic forming machine has significant merit. Once the machine cost is amortized, the price part cost drops dramatically from $1.86 to $0.74, which is only 55% of the existing equipment scenario manufactured cost. (The existing equipment scenario cost stays relatively constant regardless of future volume.) This machine is fully automatic, producing one finished part approximately every 3 seconds from a large coil of strip material. It will likely have little scrap and maintain consistent quality as it eliminates hand-feeding operations. In addition, it does not consume any of the existing LEAD equipment capacity.

5.3 Purchase finished parts from an outside vendor.

Purchasing from an outside vendor appears to be less desirable, as tooling must be purchased for a stamping press, resulting in the highest initial part cost, and once the tooling is amortized, the piece part cost is about the same as in-house manufactured without the benefit of generating any direct labor.

5.4 Timing.

Because of the requirement to begin shipments in December 2006, it is necessary to begin manufacture in-house immediately using the LEAD manufacture in-house using existing equipment and new tooling for the manually operated press brake.

In addition, the lead-time to purchase an automatic machine or buy from an outside vendor is 10-12 weeks, which requires LEAD to manufacture parts thru March 2007, as a minimum, if either of the last 2 scenarios is chosen.

5.5 Total Costs.

Table 3 summarizes the total costs, including amortization of tooling, of each of the three scenarios.

The areas highlighted in yellow are for parts manufactured at LEAD.

The costs for a future order of the same size are shown in the last 2 columns.

Table 3. Total Costs

Delivery Schedule and Costs

Month Qty	Cost Each $	Dec 500	Jan 2500	Feb 5000	Mar 7000	Apr 7000	May 7000	Jun 7000	Jul 7000	Aug 7000	Sep 2000	Total 52000	Future Cost	Future Cost (52000)
LEAD make Cost $	1.44	722	3610	7220	10108	10108	10108	10108	10108	10108	2888	75088	Each 1.34	Total 69680
Auto Machine Cost $ (inc equip & tool)	1.86	722	3610	7220	10108	13041	13041	13041	13041	13041	3726	90591	0.74	38480
Buy Cost $ (inc tool)	2.03	722	3610	7220	10108	14175	14175	14175	14175	14175	4050	96585	1.38	71500

Attachment "A" Estimated Cost Detail

	Make vs. Buy Analysis									
	NVG Clip A3297308-2									
	Make									
	Automatic-Form Machine									
		$'s								
	Equipment & Tooling	42,000								
	Shipping	1,000								
	Installation (Electric, Air, Mounting)	1,000			LEAD labor rates					
	Startup support	1,000				$/hr	$/sec			
	Total	45,000			Sheetmetal	82.06	0.0228			
	Lead-time (wks)	12								
					Monthly man-hours and equipment utilization					
	Cycle time/part (sec)	3				(7000 parts per month)				
	Parts/ min	20			Machine	Man-hours	Equipment utilization (shifts)			
	Parts/hour	1200			Auto-form	7	1			
	Piece part cost	Cost $								
	Blanking & Forming	0.068								
	Material on xx ft roll	0.200								
	Deburring	0.010								
	Sub total (In house)	0.278								
	Coating	0.410								
	Shipping 2x	0.050								
	Sub total (Out source)	0.460								
	Total	0.738								
	Equipment amortization (40K units)	1.125								
	Grand total, 1st contract, ea	1.863								
	LEAD Manufacture	3 Up	6 Up							
	Tooling	2500	5000							
	Cycle time/part blanking (sec)	15	15							
	Cycle time/part press brake (sec)	20	15		Monthly man-hours and equipment utilization					
	Parts/min (press brake)	3	4			(7000 parts per month, 6 Up)				
	Parts/hour (press brake)	180	240		Machine	Man-hours	Equipment utilization (shifts)			
					Laser cutter	29.2	4.2			
	Piece part cost	Cost $			Press-brake	29.2	4.2			
	Blanking	0.342	0.342							
	Forming	0.456	0.342							
	Material on 4"x8" sheet	0.190	0.190							
	Deburring	0.010	0.010							
	Sub total (In house)	0.998	0.884							
	Coating	0.410	0.410							
	Shipping 2x	0.050	0.050							
	Sub total (Out source)	0.460	0.460							
	Total	1.458	1.344							
	Tooling amortization (50K units)	0.050	0.100							
	Grand total 1st contract ea	1.508	1.444							
	Buy									
	Tooling	26000								
	Piece part cost (7000/mo)	1.350								
	Shipping	0.025								
	Sub total	1.375								
	Tooling amortization (40K units)	0.650								
	Grand total, 1st contract, ea	2.025								